

CLAIMS

1. A punch and wind machine for producing a slotted wound core, said
5 machine including a punch arrangement arranged to punch apertures in a
length of material, a mandrel for receiving the punched material, a control
means and a mandrel indexing means, wherein the positioning of said punch
arrangement and said mandrel is fixed and said mandrel is arranged to be
10 rotated by the mandrel indexing means after each operation of the punch
arrangement so that a roll of punched material is formed on the mandrel, said
mandrel being rotated by an amount determined by the control means, and said
control means determining the indexed amount so that selected apertures
punched in the length of material align with one another when the material is
15 rolled onto the mandrel whereby the aligned apertures form respective slots of a
desired configuration in the core.
2. A punch and wind machine according to claim 1 wherein the desired
configuration of the slot is straight sided and radially extending.
- 20 3. A punch and wind machine according to claim 1 or claim 2 wherein the
mandrel indexing means rotates the mandrel by varying amounts.
4. A punch and wind machine according to any one of the preceding claims
wherein the slots produced in the core are radial to the roll of material and have
25 side walls which are substantially straight.
5. A punch and wind machine according to any one of the preceding claims
further including roll measuring means for measuring a dimension of the roll of
punched material on the mandrel.
- 30 6. A punch and wind machine according to claim 5 wherein the measured
dimension is provided as an input to the control means.

7. A punch and wind machine according to claim 5 or claim 6 wherein the measured dimension of the roll of punched material is the radius of the roll of punched material on the mandrel.
- 5 8. A punch and wind machine according to any one of claims 5 to 7 wherein the roll measuring means includes a linear differential transformer (LVDT).
9. A punch and wind machine according to any one of claims 5 to 8 wherein the control means is arranged to determine an index amount using an algorithm
10 and the measured dimension of the roll of punched material on the mandrel.
10. A punch and wind machine according to any one of the preceding claims further including a first roll means arranged to maintain a desired tension on the length of material during operation of the punch and wind machine.
- 15 11. A punch and wind machine according to claim 10 wherein the first roll means enables accurate pre-feed of a first portion of the length of material during a pre-feed operation of the punch and wind machine.
- 20 12. A punch and wind machine according to claim 10 or claim 11 wherein the first roll means is driven by a servo control.
13. A punch and wind machine according to any one of claims 10 to 12 further including a second roll means arranged to direct the punched material
25 onto the mandrel.
14. A punch and wind machine according to claim 13 wherein the second roll means serves to maintain the un-punched material perpendicular to the punch arrangement.
- 30 15. A punch and wind machine according to claim 14 wherein the second roll means includes a pair of free running rollers.

16. A punch and wind machine according to claim 14 wherein the second roll means includes a single running roller and wherein the angle presented by the material as it leaves the roller never crosses the horizontal plane when winding a complete roll.

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17. A punch and wind machine according to any one of the preceding claims wherein the mandrel includes a temporary fixing means arranged to attach a leading end of the material to the mandrel after the pre-feed.

10 18. A punch and wind machine according to claim 17 wherein the fixing means includes a radial slot cut into the mandrel which is arranged to receive the leading end of the material.

15 19. A punch and wind machine according to any one of the preceding claims further including cutting means for cutting the material.

20 20. A punch and wind machine according to claim 19 wherein the cutting means is provided in the form of a selectable attachment incorporated into the punch arrangement.

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21. A punch and wind machine according to any one of the preceding claims further including a welding arrangement and/or an adhesive applying arrangement for affixing a cut or loose end of the completed core by spot welding it thereto, or by applying an adhesive thereto.

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22. A punch and wind machine according to any one of the preceding claims further including a core ejection means arranged to automatically eject the core once it is completed.

30 23. A punch and wind machine according to claim 7 wherein the control means includes a digital computing element arranged to read the value of the radius of the roll of punched material on the mandrel.

24. A punch and wind machine according to claim 23 wherein the digital computing element is further arranged to calculate the change in mandrel angle that must be made in order to punch apertures in the material so as to ensure that selected apertures in the length of material align with one another when
5 rolled onto the mandrel so as to thereby forming respective slots in the core.

25. A punch and wind machine according to any one of the preceding claims wherein the control means is arranged to determine the radius of the roll of material on the mandrel, initiate the mandrel indexing means to rotate the
10 mandrel by a calculated index angle so as to draw more material around the roll of material formed on the mandrel, actuate the punch arrangement so as to cause an aperture to be punched in the length of material and then repeat this process until the desired radius of material is located on the mandrel.

15 26. A method of forming a slotted wound core having adjacent radial slots separated by an angle α , said method including the steps of:

(a) Feeding a length of material through a punch arrangement and attaching an end of the material to a mandrel;
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(b) Calculating a length BC of the material between a first point B and a second point C, where point B is the point of intercept between a punch center of the punch arrangement and the material and the second point C is the point of contact between material wound on the mandrel and a
25 roll radius measuring means;

(c) Determining a next aperture punch point position A on the material, said position A being determined by the steps of:

III. Determining the angle θ about a centre point of the mandrel
30 between a radial extending to point C and a radial forming a centre line of a slot which the aperture at point A will extend when laid against a circumference of the roll of material on the mandrel;

- IV. Determining a length AC of material between a first point A and the second point C, where AC is determined by the equation:

$$AC = \theta \left(\frac{\theta \times t}{4\pi} + r \right)$$

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Where r is the radius of the roll measured at C by the roll radius measuring means and t is the thickness of the material to be punched;

- 10 III. Calculating a length of material AB between the first point A and a third point B, where AB is determined by the equation:

$$AB = AC - BC$$

- 15 (d) Calculating a mandrel rotation index angle γ required to achieve a feed length AB;

- (e) Rotating the mandrel by index angle γ ;

- 20 (f) Punching an aperture in the material using the punch arrangement;

and

- (g) Repeating steps (b) to (f) until a desired core radius is achieved.

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27. A method of forming a slotted wound core according to claim 26 wherein the mandrel rotation index angle γ is calculated using the equation:

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$$\gamma = \frac{-r + \sqrt{r^2 + \frac{t \times AB}{\pi}}}{\frac{t}{2\pi}}$$

28. A method according to claim 27 or claim 28 further including an initial pre-feed operation during which the material is fed until it contacts the mandrel and is then fed into a mandrel fixing means.

29. A method according to any one of claims 26 to 28 wherein after one complete rotation of the mandrel, a permanent fixing means is applied to attach a first layer of material on the mandrel to a second layer so as to thereby prevent an inside diameter of the roll of material from unwinding when it is removed from the mandrel.

30. A method according to any one of claims 26 to 29 wherein when a desired outside diameter of the roll of material on the mandrel is achieved, a cutting means cuts the material at a desired point and an attaching means permanently affixes the cut end of the material to the roll so as to prevent the roll unwinding.

31. A method according to any one of claims 26 to 30 further including the step of automatically ejecting the completed roll.

32. A method according to any one of claims 26 to 31 further including the step of cutting off a first unpunched portion of the length of material on the roll so that the slots formed by the apertures in the material extend from the circumference of the roll to the centre.

33. A method according to any one of claims 26 to 32 further including the step of fixing the ends of the roll to prevent inadvertent unwinding of the roll.

34. A method according to any one of claims 26 to 33 wherein between step (a) and step (b), the initial feeding process is driven and halted using the first roll means rather than by indexing the mandrel and apertures are punched in the material at appropriate locations, resuming the feed process thereafter until
5 the material reaches the location of a mandrel fixing means.
35. A wound core manufactured in accordance with any one of claims 26 to 34.
- 10 36. A wound core according to claim 35 which is magnetically conductive.